

WHAT IS CLAIMED IS:

1. A pressure sensor device comprising:

a supporting substrate;

5 a sensor substrate having a lower surface on which a sensor section for detecting pressure is formed; and

a sealing member that is joined to an upper surface of the supporting substrate and the lower surface of the sensor substrate and forms a sealing space for sealing the sensor section between the substrates.

10 2. The pressure sensor device according to Claim 1, wherein the sensor section is formed of a surface acoustic wave element for detecting pressure.

3. The pressure sensor device according to either Claim 1 or Claim 2, wherein an inert gas fills in the sealing space.

15 4. The pressure sensor device according to Claim 2, wherein the sensor substrate is made of a piezoelectric material, and the surface acoustic wave element for detecting pressure is formed by forming an IDT electrode on a surface of the sensor substrate.

5. The pressure sensor device according to any of Claim 1 through
20 Claim 4, wherein

electrode pads to be electrically connected to the sensor section are provided within the sealing space on the lower surface of the sensor substrate, and

connecting pads to be electrically connected to the
25 electrode pads via conductive bonding members are provided within

the sealing space on the upper surface of the supporting substrate.

6. The pressure sensor device according to any of Claim 1 through Claim 5, wherein the sealing member is made of a conductive material, and is electrically connected to ground terminals provided on the supporting substrate.

7. The pressure sensor device according to any of Claim 1 through Claim 4, wherein a concave portion is formed above the sensor section on the upper surface of the sensor substrate.

8. The pressure sensor device according to Claim 7, wherein a surface acoustic wave element for reference for comparing output signals of the same and the surface acoustic wave element for detecting pressure is provided on the lower surface of the sensor substrate positioned out of the concave portion forming region within the sealing space.

9. The pressure sensor device according to Claim 8, comprising:

a first oscillating circuit that oscillates at a predetermined frequency based on a resonance frequency of the surface acoustic wave element for detecting pressure;

a second oscillating circuit that oscillates at a predetermined frequency based on a resonance frequency of the surface acoustic wave element for reference;

a difference generating circuit that generates and outputs a conversion signal by comparing an oscillation signal from the first oscillating circuit with an oscillation signal from the second oscillating circuit; and

a modulation circuit that modulates the conversion signal from the difference generating circuit and the oscillation signal from the second oscillating circuit and outputs these to the outside.

5 10. The pressure sensor device according to Claim 8, comprising:

a first oscillating circuit that oscillates at a predetermined frequency based on delay time of an electrical signal generated by the surface acoustic wave element for detecting pressure;

10 a second oscillating circuit that oscillates at a predetermined frequency based on delay time of an electrical signal generated by the surface acoustic wave element for reference;

a difference generating circuit that generates and outputs
15 a conversion signal by comparing an oscillation signal from the first oscillating circuit with an oscillation signal from the second oscillating circuit; and

a modulation circuit that modulates the conversion signal from the difference generating circuit and the oscillation signal
20 from the second oscillating circuit and outputs these to the outside.

11. The pressure sensor device according to Claim 9, wherein the both elements are arranged in line by interposing a reflector therebetween, and the reflector is shared by the surface acoustic
25 wave elements disposed on both sides of the reflector.

12. The pressure sensor device according to either Claim 9 or Claim 10, wherein a damping member that blocks transmission of surface acoustic waves or lowers the intensities of surface acoustic waves is disposed between the elements on the sensor substrate.

13. The pressure sensor device according to either Claim 9 or Claim 10, wherein the elements are arranged on the sensor substrate so that the surface acoustic wave propagation directions of the elements are parallel to each other and the elements are placed in a direction orthogonal to the surface acoustic wave propagation directions.

14. The pressure sensor device according to either Claim 9 or Claim 10, wherein the resonance frequency of the surface acoustic wave element for detecting pressure and the resonance frequency of the surface acoustic wave element for reference are different from each other.

15. The pressure sensor device according to any of Claim 9 through Claim 14, wherein an IC chip includes the first oscillating circuit, the second oscillating circuit, the difference generating circuit, and the modulation circuit, and the IC chip and the elements are mounted on the same substrate.

16. The pressure sensor device according to Claim 1, wherein the sensor substrate is made of a piezoelectric material, the sensor section is formed of a surface acoustic wave element, and

a thickness of the sensor substrate positioned immediately below the reflector near the IDT electrode is almost equal to that of the region immediately below the IDT electrode, and is gradually increased with distance from the IDT electrode.

5 17. The pressure sensor device according to Claim 16, wherein the thickness of the sensor substrate positioned immediately below the IDT electrode is less than the thickness of the sensor substrate positioned immediately below the reflector.

18. The pressure sensor device according to either Claim 9 or
10 Claim 10, wherein an electronic part element including a part of the oscillating circuits is disposed on the supporting substrate.

19. The pressure sensor device according to Claim 18, wherein the electronic part element is mounted on the upper surface of
15 the supporting substrate.

20. The pressure sensor device according to Claim 18, wherein a concave portion is formed on the upper surface or lower surface of the supporting substrate within the sealing space, and an electronic part element including the oscillating circuits is
20 embedded in the concave portion.

21. The pressure sensor device according to Claim 20, wherein the concave portion is formed on the upper surface of the supporting substrate.

22. The pressure sensor device according to Claim 18, wherein
25 one end side of one of the sensor substrate and the supporting

substrate is extended to form an extended portion while it is spaced from the other substrate, and at the extended portion, an acceleration detecting element for detecting acceleration is provided.

5 23. The pressure sensor device according to Claim 22, wherein the extended portion is formed on the sensor substrate.

24. The pressure sensor device according to either Claim 22 or Claim 23, comprising:

a transmission circuit that transmits a signal modulated
10 from the conversion signal by the modulation circuit to the outside;

an acceleration detecting circuit that outputs a predetermined electrical signal based on an acceleration detection signal from the acceleration detecting element;

15 power supply means for supplying power to the transmission circuit; and

a power supply control circuit that controls power supply from the power supply means to the transmission circuit, wherein

the power supply control circuit controls power supply
20 from the power supply means based on whether the acceleration has exceeded a threshold.

25. The pressure sensor device according to any of Claim 26 through Claim 28, wherein the acceleration detecting element is formed of a surface acoustic wave element.

25 26. The pressure sensor device according to any of Claim 18 through

Claim 25, wherein an antenna element to be electrically connected to the electronic part element is mounted on the upper surface of the supporting substrate and/or the lower surface of the sensor substrate.

5 27. The pressure sensor device according to Claim 26, wherein the antenna element is mounted outside of the sealing space.

28. The pressure sensor device according to any of Claim 18 through Claim 25, wherein an antenna pattern to be electrically connected to the electronic part element is deposited onto the upper surface
10 of the supporting substrate and/or the lower surface of the sensor substrate.

29. The pressure sensor device according to Claim 28, wherein the antenna pattern is mounted outside of the sealing space.

30. The pressure sensor device according to any of Claim 18 through
15 Claim 25, wherein an antenna pattern to be electrically connected to the electronic part element is deposited onto the upper surface of the sensor substrate.

31. The pressure sensor device according to Claim 30, wherein the antenna pattern is formed in a region except for a region
20 immediately above the surface acoustic wave element for detecting pressure.

32. The pressure sensor device according to any of Claim 28 through Claim 31, wherein the antenna pattern has a meandered form.